REMARKS

Favorable reconsideration and allowance of the present application are respectfully requested in view of the following remarks. Claims 1-31 are canceled. New claims 32-73 are added. Therefore, claims 32-73 are now pending in the present application.

Claim Rejections under 35 U.S.C. § 112

Claims 1-31 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. This rejection is respectfully traversed.

In view of the cancellation of claims 1-31 and the addition of claims 32-73, which have been amended to address the Examiner's rejection, withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claim Rejections under 35 U.S.C. § 101

Claims 27-31 stand rejected under 35 U.S.C. § 101 because the claimed recitation of a use, without setting forth any steps involved in the process. This rejection is respectfully traversed.

In view of the cancellation of claims 27-31 and the addition of claims 32-73, which do not include any "use" claims, withdrawal of the rejection under 35 U.S.C. § 101 is respectfully requested.

Claim Rejections under 35 U.S.C. § 102(b)

Claims 1, 3-10, 12-21, and 23-31 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Squires et al. ("Microfluidic Pumps and Mixers Driven by Induced-Charge Electro-osmosis, 2001"; hereinafter "Squires"). This rejection is respectfully traversed.

The rejection has been rendered moot in view of the cancellation of claims 1-31. Accordingly, withdrawal of the Examiner's rejection under 35 U.S.C. § 102(b) of claims 1, 3-10, 12-21, and 23-31 is respectfully requested.

New independent claim 32 of the present invention recites a microfluidic system including a microchannel and a pump arranged to cause fluid in the microchannel to flow under the action of secondary electroosmosis. Squires neither discloses nor suggests the above-identified claim feature.

Instead, Squires is concerned with microfluidic pumps and mixers driven by induced-charge electroosmosis. Induced-charge electroosmosis results from the action of an electric filed on its own induced diffuse charge. Therefore, the movement by induced-charge electroosmosis is caused by the movement of ions within a diffuse charge layer in response to an electric field. This is fundamentally different from the present invention which provides a microchannel and a pump arranged to cause fluid in the microchannel to flow under the action of secondary electroosmosis. The secondary electroosmosis acts on ions within a space charge region (SCR)

associated with the surface of an electrically conductive member. Therefore, a creation of an SCR is a necessary condition to observe secondary electroosmosis. It is the effect of the electric field on ions within the SCR which causes movement by electroosmosis of the second kind. In contrast, Squires is not concerned with obtaining a SCR to provide secondary electroosmosis. The diffuse charge layer disclosed in Squires is different from the SCR required by the present invention. Thus, Squires does not disclose or suggest a microfluidic system including "a microchannel and a pump arranged to cause fluid in the microchannel to flow under the action of secondary electroosmosis" as recited in claim 32 of the present invention.

Claim 34 is dependent on claim 32 and is considered patentable for the reasons presented above with respect to claim 32. Claim 34 is also considered patentable because Squires fails to disclose or suggest that "wherein the space between the electrically conductive member and the walls of the microchannel, and between different electrically conductive members, is between 0 a and 2 a_{CHAR}, the surface of the at least one electrically conductive member being smooth such that the surface irregularities are less than 5% of d_{CHAR}." The present invention provides that in order to cause fluid in the microchannel to flow under secondary electroosmosis as in the present invention, it is important for the space between the electrically conductive member and the walls of the microchannel and the space between different electrically conductive members, to be 0 a_{CHAR} and 2 a_{CHAR}. The Examiner contends that Figure 14 and Page 9, 2nd paragraph of Squires discloses the feature. Applicants respectfully disagree. The cited portion of Squires merely shows conducting means in contact with the channel walls. However, Squires does not disclose or suggest that the space between the electrically conductive members is between 0 a_{CHAR} and 2

a_{CHAR}. In fact, it appears that the distance between opposing conductive members is much greater than 2 a_{CHAR} in Squires. In addition, unlike the present invention, there is no mention in Squires that the spacing between opposing conductive members is important. Thus, contrary to the assertion by the Examiner, nowhere in Squires is there a disclosure or suggestion of "wherein the space between the electrically conductive member and the walls of the microchannel, and between different electrically conductive members, is between 0 a_{CHAR} and 2 a_{CHAR}" as recited in claim 34 of the present invention.

In addition, claim 34 recites that the surface of the at least one electrically conductive member is smooth such that the surface irregularities are less than 5% of d_{CHAR}.

In contrast, Squires is not concerned with the level of smoothness of the conductive members. Squires is merely directed to generating induced-charge electroosmosis by the movement of ions within a diffuse charge layer in response to an electric field. There is no disclosure in Squires to indicate that the smoothness of the conducting member is necessary when generating induced charged electroosmosis. In fact, Figure 14 of Squires shows flows generated by a patterned metallic surface with asymmetric ridges. Therefore, if the row of ridges on either side of the microchannel is taken to form a single conductive member, then it is clear that the surface does not have the smoothness required in the present invention. But even if each ridge is taken to be a separate element, there is still no disclosure or suggestion that the surface is smooth such that the surface irregularities are less than 5% of d_{CHAR}. Unlike the present invention, smoothness is important to generate SCR to cause fluid in a microchannel to flow under the action of secondary electroosmosis. Thus, Squires neither discloses nor suggests "the surface of the at least one

electrically conductive member being smooth such that the surface irregularities are less than 5% of d_{CHAR}" as recited in claim 34 of the present invention.

Independent claim 69 recites "A method for pumping fluid in a microchannel comprising the step of applying an electric field to a conductive member in said microchannel sufficient to cause fluid in said microchannel to flow as a result of secondary electroosmosis." As discussed with respect to claim 32 above, Squires is not concerned with providing secondary electroosmosis. Thus, Squires neither teaches nor suggests at least the above-identified claim feature.

In view of the above remarks regarding independent claims 32 and 69 it is respectfully submitted that Squires does not anticipate the present claimed invention as claimed in independent claims 32 and 69. As claims 33-68 and 70-73 are dependent on independent claims 32 and 69 respectively, it is respectfully submitted that claims 33-68 and 70-73 are also patentable for the same reasons as discussed above in regards to independent claims 32 and 69. Applicants respectfully request that these new claims be allowed.

Claim Rejections under 35 U.S.C. § 103(a) – Squires

Claims 1, 3-10, 12-21, and 23-31 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Squires et al. ("Microfluidic Pumps and Mixers Driven by Induced-Charge Electro-osmosis, 2001"; hereinafter "Squires"). This rejection is respectfully traversed.

The rejection has been rendered moot in view of the cancellation of claims 1-31. Accordingly, withdrawal of the Examiner's rejection under 35 U.S.C. § 103(a) of claims 1, 3-10, 12-21, and 23-31 is respectfully requested.

New independent claim 32 of the present invention provides a microfluidic system including a microchannel and a pump arranged to cause fluid in the microchannel to flow under the action of secondary electroosmosis. As discussed above, Squires is not concerned with providing secondary electroosmosis. Thus, Squires neither teaches nor suggests at least the above-identified claim feature.

Claim 34 is dependent on claim 32 and is considered patentable for the reasons presented above with respect to claim 32. Claim 34 is also considered patentable because Squires fails to teach or suggest that "wherein the space between the electrically conductive member and the walls of the microchannel, and between different electrically conductive members, is between 0 a_{CHAR} and 2 a_{CHAR}, the surface of the at least one electrically conductive member being smooth such that the surface irregularities are less than 5% of d_{CHAR}." The present invention provides that in order to cause fluid in the microchannel to flow under secondary electroosmosis as in the present invention, it is important for the space between the electrically conductive member and the walls of the microchannel and the space between different electrically conductive members, to be 0 a_{CHAR} and 2 a_{CHAR}. The Examiner contends that Figure 14 and Page 9, 2nd paragraph of Squires discloses the feature. Applicants respectfully disagree. The cited portion of Squires merely shows conducting means in contact with the channel walls. However, Squires does not

disclose or suggest that the space between the electrically conductive members to be between 0 a_{CHAR} and 2 a_{CHAR}. In fact, it appears that the distance between opposing conductive members is much greater than 2 a_{CHAR} in Squires. In addition, unlike the present invention, there is no mention that the spacing between opposing conductive members is important. Thus, contrary to the assertion by the Examiner, nowhere in Squires is there a disclosure or suggestion of "wherein the space between the electrically conductive member and the walls of the microchannel, and between different electrically conductive members, is between 0 a_{CHAR} and 2 a_{CHAR}" as recited in claim 34 of the present invention.

The Examiner is correct in stating that Squires does not disclose that the surface irregularities of the conducting means being less than 5% of d_{CHAR} (see Page 7, Office Action). However, the Examiner asserts that for the purpose of providing less drag on the fluid flow across the conducting means and less fluid trapped within the mixer, it would have been obvious to one with ordinary skill in the at the time of the invention to have the conducting means of Squire to have a smooth surface with irregularities of less than 5% of d_{CHAR}. Applicants respectfully disagree. The Examiner's allegation is entirely unfounded and unsupported that there is no indication in Squires that drag or retention of analyte is a problem with the pumps and mixers operated by induced charge electroosmosis. Contrary to the assertion by the Examiner, as the movement is generated within the diffuse charge layer surrounding the conducting means, induced charge electroomosis movement will not be significantly influenced by drag, which would be expected to affect passive surfaces with a viscous drag. Therefore, it would not have been obvious one with ordinary skill in the art at the time of the invention to modify a system

arranged to operate via induced charged electroosmosis in Squires to ensure the level of smoothness as required by the present invention. Thus, Squires neither discloses nor suggests "the surface of the at least one electrically conductive member being smooth such that the surface irregularities are less than 5% of d_{CHAR}" as recited in claim 34 of the present invention.

Independent claim 69 recites "A method for pumping fluid in a microchannel comprising the step of applying an electric field to a conductive member in said microchannel sufficient to cause fluid in said microchannel to flow as a result of secondary electroosmosis." As discussed with respect to claim 32 above, Squires is not concerned with providing secondary electroosmosis. Thus, Squires neither teaches nor suggests at least the above-identified claim feature.

In view of the above remarks with respect to independent claims 32 and 69, it is respectfully submitted that independent claims 32 and 69 are not made unpatentable by Squires. As claims 33-68 and 70-73 are dependent on independent claims 32 and 69 respectively, it is respectfully submitted that claims 33-68 and 70-73 are also patentable for the same reasons as discussed above in regards to independent claims 32 and 69. Applicants respectfully request that these new claims be allowed.

Claim Rejections under 35 U.S.C. § 103(a) – Squires, Noca

Claim 2 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Squires et al. ("Microfluidic Pumps and Mixers Driven by Induced-Charge Electro-osmosis, 2001";

hereinafter "Squires") and further in view of Noca et al. (US Patent No. 6,685,810; hereinafter "Noca"). This rejection is respectfully traversed.

The rejection has been rendered moot in view of the cancellation of claims 1-31. Accordingly, withdrawal of the Examiner's rejection under 35 U.S.C. § 103(a) of claim 2 is respectfully requested.

Claim 35 corresponds to canceled claim 2. Claim 35 is dependent on claim 32 and it is demonstrated above that claim 32 is distinguishable over Squires. Noca does not remedy at least the above noted deficiencies of Squires. Noca describes a device for utilizing a non-gel self-assembled nano-feature array molecular sieve for analyzing molecules. The molecular sieve device includes an ordered array of self-assembled nano-features which function as a molecular sieve to separate molecules based on a suitable characteristic (see Abstract, Noca). However, similar to Squires, Noca is not concerned with providing "a microchannel and a pump arranged to cause fluid in the microchannel to flow under the action of secondary electroosmosis" as recited in claim 32 of the present invention.

In view of the above remarks with respect to independent claim 32, it is respectfully submitted that independent claim 32 is not made unpatentable by Squires and Noca when taken alone or in combination. As claim 35 is dependent on independent claim 32, it is respectfully submitted that, in addition to the above remarks, the claim is also patentable for the same reasons

discussed above with respect to independent claim 32. Applicants respectfully request that the new claim be allowed.

Claim Rejections under 35 U.S.C. § 103(a) – Squires, Guinn, Chow

Claim 11 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Squires et al. ("Microfluidic Pumps and Mixers Driven by Induced-Charge Electro-osmosis, 2001"; hereinafter "Squires") and further in view of Guinn et al. (US Patent No. 6,677,832; hereinafter "Guinn") and Chow et al. (US Patent No. 6,149,787). This rejection is respectfully traversed.

The rejection has been rendered moot in view of the cancellation of claims 1-31. Accordingly, withdrawal of the Examiner's rejection under 35 U.S.C. § 103(a) of claim 11 is respectfully requested.

Claims 47 and 48 correspond to canceled claim 11. Claims 47 and 48 are dependent on claim 32 and it is demonstrated above that claim 32 is distinguishable over Squires. Guinn and Chow do not remedy at least the above noted deficiencies of Squires. Guinn describes an electrical connecting element employing differential-mode signaling such that the first conductor path carries a signal of opposite polarity to the second conductor path. A virtual ground exists between the differential + and - lines that permits an otherwise "groundless" differential transmission line (see Abstract, Guinn). Chow describes a system for introducing large numbers of different materials into a microfluidic analytical device rapidly, efficiently and reproducibly. In particular, improved integrated pipettor chip configurations, e.g. sippers or electropipettors,

are described which are capable of sampling extremely small amounts of material for which analysis is desired, transporting material into a microfluidic analytical channel network, and performing the desired analysis on the material (see Abstract, Chow). However, similar to Squires, neither Guinn nor Chow is concerned with providing "a microchannel and a pump arranged to cause fluid in the microchannel to flow under the action of secondary electroosmosis" as recited in claim 32 of the present invention.

In view of the above remarks with respect to independent claim 32, it is respectfully submitted that independent claim 32 is not made unpatentable by Squires, Guinn, and Chow when taken alone or in combination. As claims 47 and 48 are dependent on independent claim 32, it is respectfully submitted that, in addition to the above remarks, the claims are also patentable for the same reasons discussed above with respect to independent claim 32. Applicants respectfully request that these new claims be allowed.

Claim Rejections under 35 U.S.C. § 103(a) – Squires, Zanzucchi

Claim 22 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Squires et al. ("Microfluidic Pumps and Mixers Driven by Induced-Charge Electro-osmosis, 2001"; hereinafter "Squires") and further in view of Zanzucchi et al. (US Patent No. 5,985,119; hereinafter "Zanzucchi"). This rejection is respectfully traversed.

The rejection has been rendered moot in view of the cancellation of claims 1-31. Accordingly, withdrawal of the Examiner's rejection under 35 U.S.C. § 103(a) of claim 22 is respectfully requested.

Claim 59 corresponds to canceled claim 22. Claim 59 is dependent on claim 32 and it is demonstrated above that claim 32 is distinguishable over Squires. Zanzucchi does not remedy at least the above noted deficiencies of Squires. Zanzucchi describes methods of performing a synthetic process in a liquid distribution system having reaction cells, by pumping at least one reagent into a reaction cell (see Abstract, Zanzucchi). However, similar to Squires, Zanzucchi is not concerned with providing "a microchannel and a pump arranged to cause fluid in the microchannel to flow under the action of secondary electroosmosis" as recited in claim 32 of the present invention.

In view of the above remarks with respect to independent claim 32, it is respectfully submitted that independent claim 32 is not made unpatentable by Squires and Zanzucchi when taken alone or in combination. As claim 59 is dependent on independent claim 32, it is respectfully submitted that, in addition to the above remarks, the claim is also patentable for the same reasons discussed above with respect to independent claim 32. Applicants respectfully request that the new claim be allowed.

CONCLUSION

In view of the above amendments, it is believed that the pending application in condition for allowance. Applicants respectfully request that the pending application be allowed.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Dennis P. Chen, Registration No. 61,767 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§ 1.16 or 1.147; particularly, extension of time fees.

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Respectfully submitted,

By 

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